

# Urban Water Security Research Alliance



## Development of Methods for the Improved Recovery and Detection of Viruses in Water

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Purified Recycled Water

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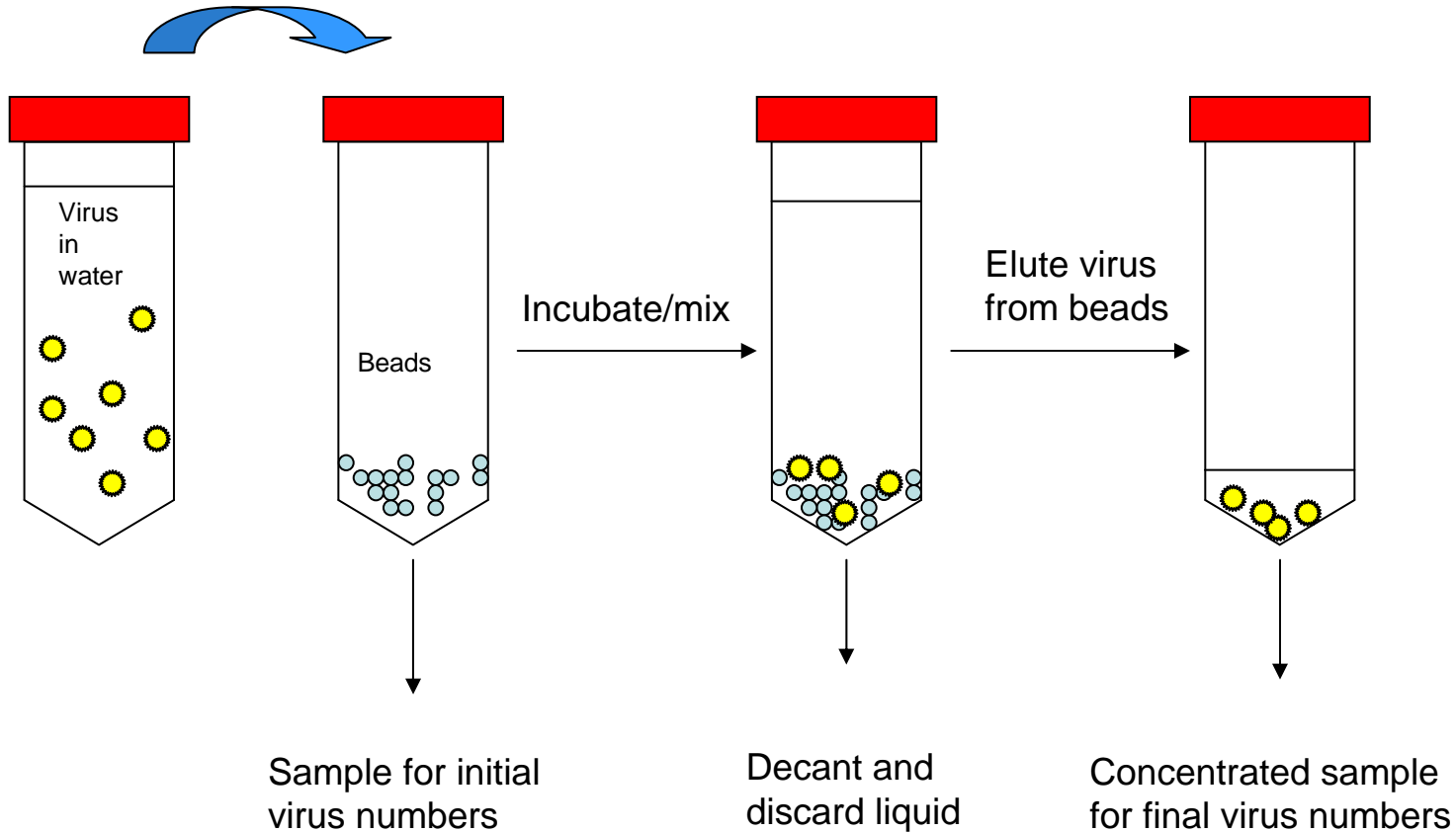
# Project Background

- Existing methods include positively charged cartridge filters (US EPA), glass wool, charged membranes, and immunomagnetic capture.
- Most of these methods have low recovery efficiency and are unable to be used with low quality water.
- Virus are negatively charged and can be captured to a suitable charged surface via electrostatic binding.
- Positively charged membranes.
- Negatively charged membranes.
- Preconditioning of water to facilitate binding (low pH and  $\text{AlCl}_3$  or  $\text{MgCl}_2$ ).

# Methodology

- Positively charged Millipore Immoblin NY+ membranes.
- Negatively charged HA type membranes (Millipore).
- Polystyrene beads (3-5mm diameter) without charge modification.
- Silica particles (60-100 mesh) without charge modification.

# Virus Concentration approach



# Laboratory set up for virus capture experiments



# Adenovirus capture with negatively charged HA membranes

Sample ID	Initial virus concentration in water 100mL (PDU/mL)	Virus concentration in eluate 1mL (PDU/mL)	% Recovery
<b>Adenovirus</b>			
Cut membrane A	$6 \times 10^5$	$9.15 \times 10^6$	18.30
Cut membrane B	$5.85 \times 10^5$	$8.50 \times 10^6$	14.53
Full membrane A	$6.80 \times 10^5$	$4.91 \times 10^7$	72.21
Full membrane B	$5.35 \times 10^5$	$3.17 \times 10^7$	59.25

# Virus capture with polystyrene beads

Sample ID	Initial virus concentration in water 10mL (PDU/mL)	Virus concentration in eluate 1mL (PDU/mL)	% Recovery
<b>Coxsackievirus</b>			
A	$6 \times 10^7$	$3.01 \times 10^6$	0.50
B	$1.07 \times 10^8$	$4.64 \times 10^6$	0.43
<b>Adenovirus</b>			
A	$1.70 \times 10^8$	$2.13 \times 10^7$	1.25
B	$2.58 \times 10^8$	$1.60 \times 10^7$	0.62

# Virus capture with silica beads

Sample ID	Initial virus concentration in water 10mL (PDU/mL)	Virus concentration in eluate 1mL (PDU/mL)	% Recovery
<b>Coxsackievirus</b>			
A	$1.17 \times 10^6$	$3.06 \times 10^6$	26.11
B	$1.17 \times 10^6$	$8.55 \times 10^5$	7.31
<b>Adenovirus</b>			
A	$1.67 \times 10^6$	$4.90 \times 10^6$	29.40
B	$1.50 \times 10^6$	$2.53 \times 10^6$	16.83

# Conclusions

- Negatively charged membranes work better.
- Surface area plays an important role in the capture of virus.
- Silica beads are more promising and modification is easier.
- Amino-functionalised (modified) silica particles.

Thank you

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